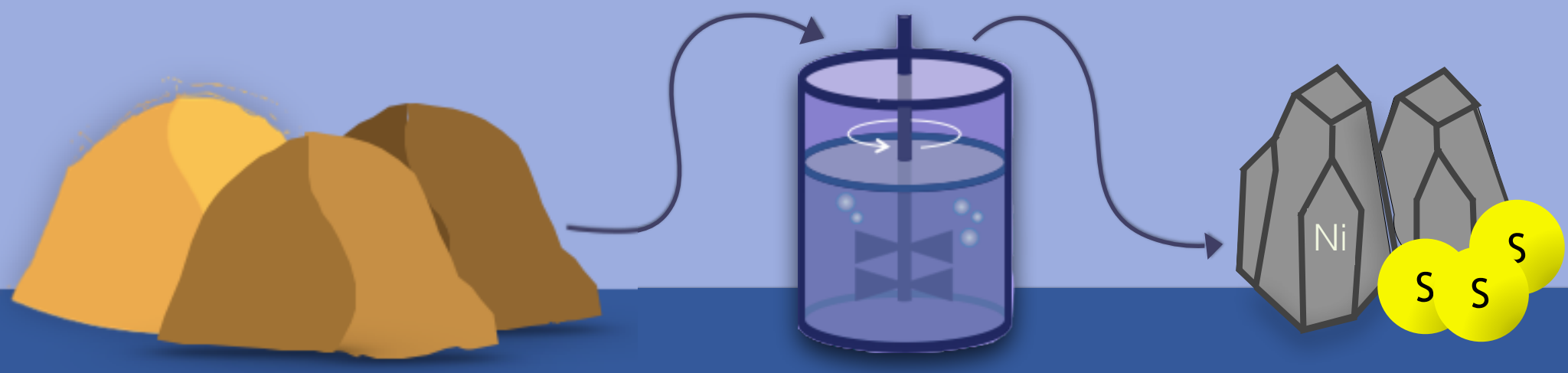
Elements of Bio-mining

High-temperature economic tailings bioleach

Sulfide-laden waste tailings pose a risk of acid mine drainage.

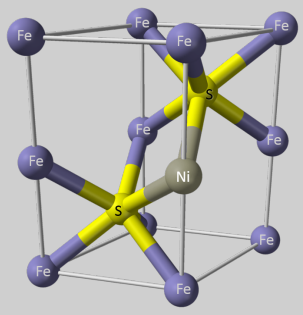
Our solution: develop a microbial driven process that stabilizes sulfur, preventing acid mine drainage, while funding treatment by facilitating base metal recovery.



Objectives

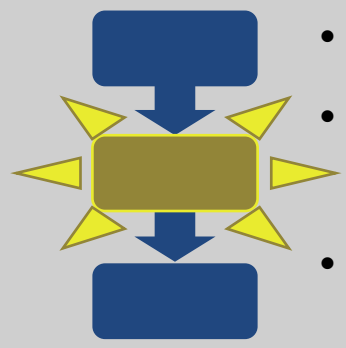
- Identify or engineer thermophilic acidophilic iron-oxidizing bacteria that release base metals and stabilize sulfur
- Genome scale model and genetic tools for thermophilic acidophiles
- Find novel metal-binding proteins to improve process kinetics and new applications
- Develop high-temperature pyrrhotite tailings bioleach process
- Identify value-added uses for recovered sulfur
- Technoeconomic analysis of bioprocess implemented at industrial scale

Methods



- Batch and continuous culturing of thermophilic acidophilic microbes oxidizing pyrrhotite
- Screening to identify metal-binding molecules
- Metabolic engineering
- Bioprocess and economic modelling and advanced process control

Industry engagement



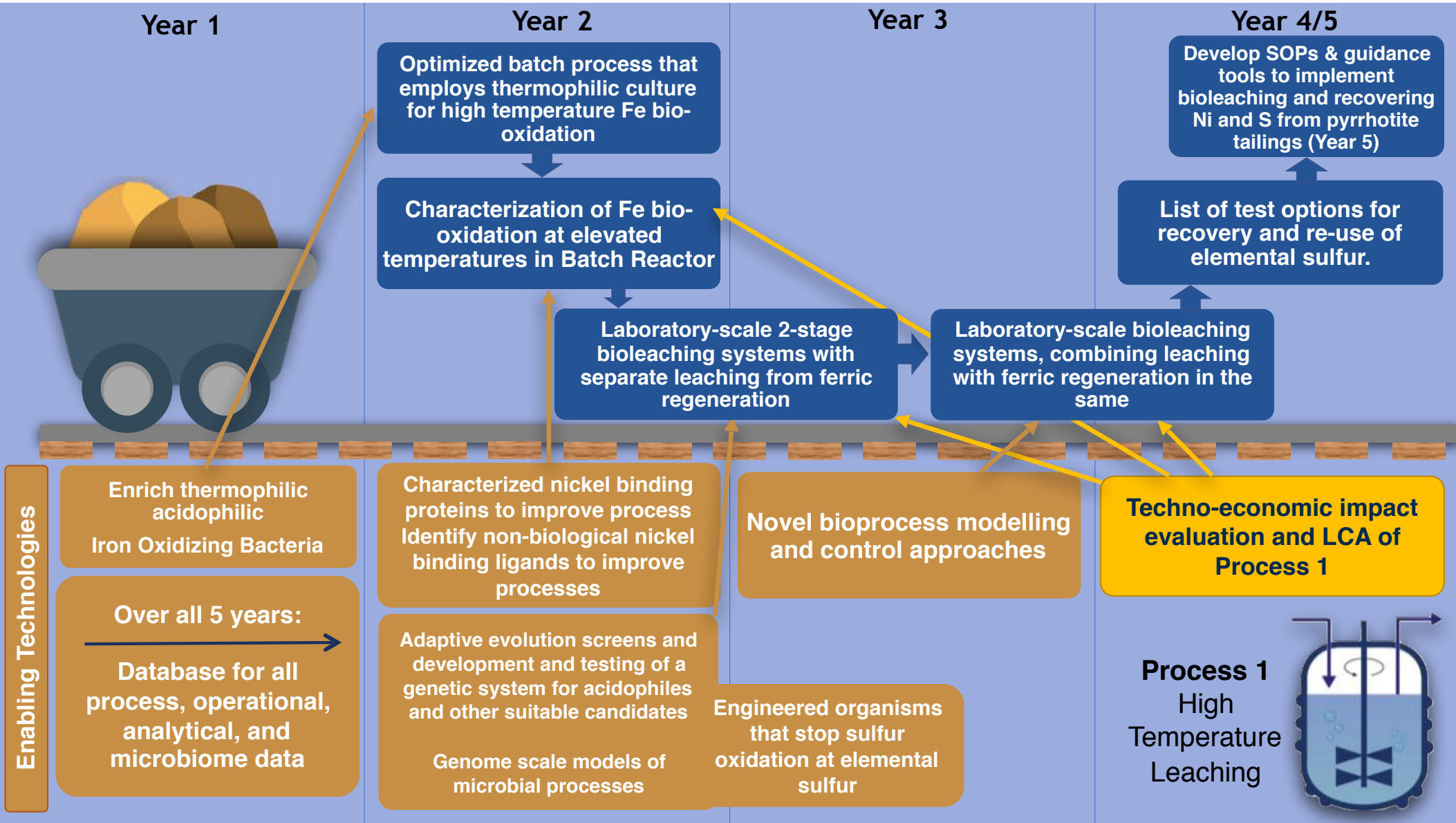
- Pyrrhotite tailings samples
- Integration of process in current operations
- Data for technoeconomic analysis

Risk: Economic viability of process if market for sulfur not available

Deliverables for industry

The following bioprocesses such as microbial cultures, bioreactors, and SOPs are for recovering nickel and stabilizing sulfur from high sulfur tailings.

- Collection of thermophilic acidophilic cultures capable of oxidizing pyrrhotite and stabilizing sulfur
- Database of metal binding proteins (and molecules) for use in bioleach and separation technologies
- Genome models and platform to genetically modify thermophilic acidophiles for a range of applications


Year 1
Year 2
Year 3
Year 4/5
Optimized batch process that employs thermophilic culture for high temperature Fe bio-oxidation
Develop SOPs & guidance tools to implement bioleaching and recovering Ni and S from pyrrhotite tailings (Year 5)
Characterization of Fe bio-oxidation at elevated temperatures in Batch Reactor
List of test options for recovery and re-use of elemental sulfur.
Laboratory-scale 2-stage bioleaching systems with separate leaching from ferric regeneration
Laboratory-scale bioleaching systems, combining leaching with ferric regeneration in the same
Enabling Technologies
Enrich thermophilic acidophilic
Iron Oxidizing Bacteria
Characterized nickel binding proteins to improve process
Identify non-biological nickel binding ligands to improve processes
Novel bioprocess modelling and control approaches
Techno-economic impact evaluation and LCA of Process 1
Over all 5 years:
Database for all process, operational, analytical, and microbiome data
Adaptive evolution screens and development and testing of a genetic system for acidophiles and other suitable candidates
Genome scale models of microbial processes
Engineered organisms that stop sulfur oxidation at elemental sulfur
Process 1
High Temperature Leaching